REMARKS

Claims 1-7 and 17-20 were examined. No claims are amended. Claims 1-7 and 17-20 remain in the application.

A. 35 U.S.C. §102(b) or §103(a): Rejection of Claims 1-4 & 6-7

The Patent Office maintains its rejection of claims 1-4 and 6-7 under 35 U.S.C. §102(b) as anticipated by or under 35 U.S.C. §103(a) as obvious over "Role of N_2 Addition on CF_4/O_2 Remote Plasma Chemical Dry Etching of Polycrystalline Silicon," Matsuo et al. (Matsuo).

Independent claim 1 describes an apparatus including a first reaction chamber, a gas source coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber and an excitation energy source coupled to the first reaction chamber to generate a nitrogen plasma comprising nitrogen ions and radicals from the nitrogen gas. The apparatus also includes a second reaction chamber adapted to house a substrate for film formation at a site in the second reaction chamber. The first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate in a film conversion step.

(1) Film formation

The Patent Office states that "it has been well established in prior action that Matsuo teaches both etching and film formation processes - page 1805." Applicants strongly disagree that this is well established. Matsuo teaches only chemical dry etching. It is true that in the chemical dry etching processes that it analyzes, a "reaction layer" is formed (e.g., a "SiF_xO_y reaction layer" (page 1805). Apparently, the Patent Office believes a reaction layer formed during removal of material is sufficient to constitute an apparatus suitable for forming a film on a substrate. Applicants question whether this obviously transient layer in the context of etching (i.e., removing silicon) can constitute film formation.

(2) Radicals react with the substrate in a film conversion step

The Patent Office states that the requirement that nitrogen be incorporated into a reaction layer is a statement of intended use of the claimed apparatus. Applicants strongly disagree. The separation of a first reaction chamber and a second reaction chamber in claim 1 is described so that only nitrogen radicals and, for example, not nitrogen ions, are available to react with a substrate in a film conversion step. This is a specific limitation on a separation distance between chambers. It is

specifically stated in claim 1. If the chambers were separated by a distance less than equivalent to a lifetime of nitrogen ions at a plasma generation rate, it follows that nitrogen ions would be available to react with a substrate. If the distance is equivalent to the lifetime of the nitrogen ions, the nitrogen ions are not present. Thus, there is a quantifiable separation distance between a first chamber and a second chamber that meets this criteria. This quantifiable distance is a structural limitation of claim 1.

Matsuo does not say anywhere that nitrogen radicals react with a substrate in a film conversion step. In fact, the action of nitrogen (either radicals or ions) is not identified by Matuso - only its resulting effect. With regard to forming a reaction layer, it is not clear that nitrogen (either radicals or ions) are incorporated in a reaction layer.

> Strong surface chemical changes are observed upon N_2 addition, although little nitrogen is incorporated in the reaction layer. The nitrogen is reactive only as a reactive intermediate. Depending on the O_2/CF_4 ratio, i.e., the predominance of F or O, either thinning or thickness growth of the modified surface layer can be seen.

Matsuo, page 1813 (says nothing about nitrogen radicals reacting with a substrate in a film conversion step).

> Even though nitrogen plays a profound role in the etching of silicon, it is not incorporated in a stable reaction layer."

Matsuo, page 1806 (does not say that nitrogen radicals react with a substrate in a film conversion step).

The Patent Office states "Matsuo states the separation distance plays a major role in which reactive species survived in which the processing chamber (Section III.B.2, page 1803, second sentence)." Applicants fail to see how this statement supports a finding that a plasma applicator should be separated from etch processing chamber by distance equivalent to the lifetime of nitrogen ions. Applicants include a copy of Figure 4 of Matsuo. The inverted triangles in each case represent nitrogen addition to etch chemistries to etch polysilicon. Note this language says nothing about whether the nitrogen is converted to a plasma of ions and radicals and whether or not only the radicals survive to a reaction chamber. Further, as clearly evident by each figure, where nitrogen is added, the etch rate is best at zero separation. Clearly, the teaching here, with respect to etching, is that if nitrogen is to be used, there should be no separation between the applicator and the etch chamber. Therefore, Matsuo cannot anticipate claim 1 with regard to a suitable separation of the applicator and etch chamber.

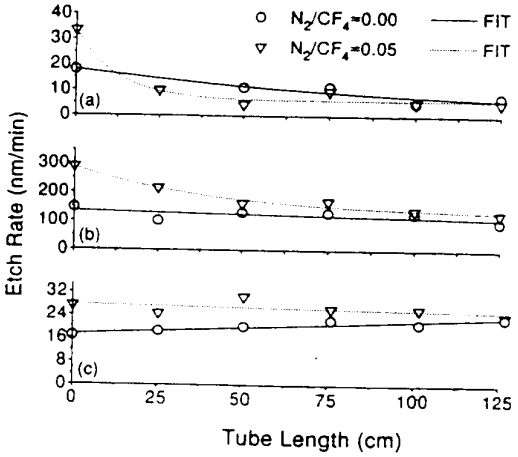

FIG. 4. Poly-Si etch rate vs quartz lined transport tube length. Panel (a) represents an O_2/CF_4 ratio of 0.00, (b) 0.15, and (c) 0.75.

In terms of obviousness, the Patent Office states that "[m]otivation for Matsuo to optimize the operation of the apparatus to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate is to form a desired film." First, Matsuo is not concerned with forming a film. Matsuo is removing silicon. Second, Applicants remind the Patent Office that the mere fact that a reference or references might be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. MPEP Section 2143.01. In this case, clearly Matsuo does not teach separating an applicator and an etch rate chamber when nitrogen addition is contemplated, but instead teaches the exact opposite.

For the above stated reasons, claim 1 is not anticipated by and is not obvious over Matsuo. Claims 2-4 depend from claim 1 and therefore include all the limitations of that claim. For at least the reasons stated with respect to claim 1, claims 2-4 are not anticipated by and are not obvious over Matsuo.

Independent claim 6 describes an apparatus including a first reaction chamber; means for supplying a nitrogen gas to the first reaction chamber; and means for generating a plasma from the nitrogen gas. The apparatus also includes a second reaction chamber having means for housing a substrate for film formation processing and means for providing the plasma to the second reaction chamber substantially free of nitrogen ions such that radicals from the plasma react with a substrate in a process conversion step.

Claim 6 is not anticipated by and is not obvious over Matsuo, because Matsuo does not describe, among other things, means for providing a plasma of nitrogen to a reaction chamber substantially free of nitrogen ions such that radicals react with a substrate housed for film formation in a process conversion step. Applicants can find no teaching in Matsuo that describes the state of the nitrogen species once it is in the chamber. Presumably, the Patent Office sites tube lengths similar to those described in Applicant's specification for teaching only radicals are present. As a preliminary matter, Matsuo favors a much shorter tube length distance when nitrogen is introduced. Second, there is no teaching in Matsuo that nitrogen radicals are available to react with a substrate.

The means for providing between the radicals to the second reaction chamber in claim 6 is a structural limitation of the apparatus in that, it at least establishes a relationship between generated plasma and the second reaction chamber. Representatively, where a second chamber is placed too close to a first chamber, nitrogen ions as well as radicals could be available to react with a substrate in a process conversion step.

In terms of the obviousness of claim 6 over Matsuo, Applicants again point to Figure 4 above and the discussion of Matsuo with respect to claim 1. The mere fact that Matsuo conducted experiments that clearly show that no separation between an applicator and an etch chamber is clearly optimal in the context of nitrogen use as opposed to a separation cannot render a claim that teaches a separation obvious since there is certainly no suggestion to separate the applicator and the etch chamber. See MPEP 2143.01.

Independent claim 6 is not anticipated by and is not obvious over Matsuo. Claim 7 depends from claim 6. For at least the reasons stated with respect to claim 6, claim 7 is not anticipated by and is not obvious over Matsuo.

B. 35 U.S.C. §102(b): Rejection Claims 17-20

The Patent Office rejects claims 17-20 under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 5,082,517 issued to Moslehi (Moslehi).

Independent claim 17 relates to a system including a first chamber; a nitrogen gas source coupled to the first chamber and an energy source coupled to the first chamber. The system also includes a second chamber configured to house a substrate for film formation processing and a system controller configured to control the introduction of a gas from the gas source into the first chamber and to control the introduction of an energy from the energy source. The system also includes a memory coupled to the controller and instructions for controlling the gas source and the energy source to convert a portion of a nitrogen gas supplied by the gas source into a plasma. The

first reaction chamber is separated from the second reaction chamber by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate such that radicals react with a substrate in the second chamber in a film conversion step.

Independent claim 17 is not anticipated by Moslehi, because Moslehi does not describe a system including a first reaction chamber and a second reaction chamber that are separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate such that radicals react with a substrate in the second chamber in a film conversion step. Moslehi teaches preferably introducing both charged and neutral species to a process chamber. The Patent Office states that Moslehi teaches a plasma density controller capable of controlling "the concentration" of activated ions and neutral species. This, however, is not a teaching anticipating a relationship between the plasma generation tube and a process chamber (e.g., the distance between the plasma generation tube and a process chamber) equivalent to the lifetime of nitrogen ions.

For the above stated reasons, claim 17 is not anticipated by Moslehi. Claims 18-20 depend from claim 17 and therefore contain all the limitations of that claim. For at least the reasons stated with respect to claim 17, claims 18-20 are not anticipated by Moslehi.

Applicants respectfully request that the Patent Office withdraw the rejection to claims 17-20 under 35 U.S.C. §102(b).

C. 35 U.S.C. §103(a): Rejection of Claim 5

Claim 5 is rejected under 35 U.S.C. §103(a) as obvious over Matsuo in view of U.S. Patent No. 6,130,118 issued to Yamazaki (Yamazaki). Yamazaki is cited for describing a plasma reaction apparatus for film deposition.

Claim 5 depends from claim 1 and therefore contain all the limitations of that claim. Accordingly, claim 5 is not obvious over the cited references because the references do not disclose or provide any motivation for an apparatus including a first reaction chamber coupled to a second reaction chamber having a substrate site separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate.

Applicants respectfully request that the Patent Office withdraw the rejection to claim 5 under 35 U.S.C. §103(a).

CONCLUSION

In view of the foregoing, it is believed that all claims now pending patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

Respectfully submitted,
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